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PERFORMANCE EVALUATION OF POWER THRESHER FOR WHEAT CROP

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ABSTRACT

Studied the effect of front to rear clearance ratios of 3:1 to 1:1 and found very little difference in cylinder loss, visible damage and germination of wheat for any given mean clearance. Front to rear clearance convergence is generally desirable because the wider front opening tends to improve the feeding characteristics of cylinder. He also reported that increasing concave length increased separation of grain. Based on the design and operational parameters for a Wheat thresher Johnson (1959) a prototype. Thresher was modified, developed and evaluated. The thresher was evaluated at three different levels each of cylinder concave clearance (10, 20, 30 mm), seed moisture content (12.5, 14.0. 17.0%), two levels of cylinder speed (580,600 rpm peripheral speed 4.2m/s and 4.4m/s), and feed rate 10kg/hr of dried wheat. Performance parameters for the study were threshing efficiency, cleaning efficiency, total loss of seed and germination. The test results indicated a maximum of 97% threshing efficiency and 97.7% cleaning efficiency, a minimum of 3.3% total seed loss and a maximum germination of 85%. The average output capacity of machine was 6.3kg/hr of seed. The performance was found to be influenced by all the study variables.

KEYWORDS: Thresher, Performance, Wheat, Threshing Efficiency, Cleaning Efficiency

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INTRODUCTION

Agriculture has been and will continue to be the lifeline of Indian economy. As the largest private enterprise in India, agriculture contributes nearly one fourth of national GDP, sustains live-hood of about two-thirds total population and is the backbone of agro based industry. In food sector alone agriculture contributes about Rs.250 thousand crores annually. Through the modern agricultural technologies India has moved from an era of chronic food shortages and “begging bowl” status up to 1960s to food self-sufficiency and even food exports. The technology led sustainable growth in almost all sectors is important. Since 1950s, the productivity gains are nearly 3.3 times in food grains.

India is the second largest wheat producer after China. Wheat is grown under diverse agro climatic conditions and occupies more than 25 million hectare area with average production of 70 million tonnes in 2004-05 which exceeds last year’s production by 1.94 million tones or 2.8% (India2006). Uttar Pradesh as the major *Rabi* crop, it recorded area 9.51 million hectare with average production of 28.55 million tonnes in 2008-09 and current year cropped area 9.25 million hectare with average production of 30.09 million tonnes in 2009-10**.** Threshing is the process of loosening and separating grain from ear heads. Traditional threshing methods followed

Original Article

by farmers involved trampling of crop under feet, beating of shelves on hard slant surface, beating crop with a flail, treading a layer of 150 to 200mm thick harvested crop by a team of animal. These traditional methods are not only time consuming and involves drudgery but also have poor efficiency and very low out- put. On an average four quintals per day can be threshed by a pair of bullock. With the advancement, farmers started the use of dragging devices like rollers, wooden planks, disc harrow finally Olpad thresher. Power thresher is a machine which is use to detach grains from the harvested crop and separate clean threshed grain from the chaff, without much loss or damage. The power threshers are becoming increasingly popular and are used 5 to 10 hp stationary engine, electric motor or tractor. The drum rotate at 500 to 1100 rpm and are of peg type, angle iron type, loop type, rasp bar type and hammer mill type. Most common are peg type in which bolts are used on the periphery of the drum. The power Thresher of different sizes is available to suit different power rating of engines, electric motors and tractors.

Timely threshing of crop is essential in plane areas. There is enormous sacristy of machinery and non availability of small size machinery makes the job difficult in plane areas. Farmers use conventional method like hand beating, animal feet trampling for threshing crops. So there is a crucial need of small size wheat thresher which can make bhusa and separate bhusa from grains. The requirement of bhusa making put an essential constraint on designing wheat thresher which could thresh wheat crop efficiently. The peg type cylinders are being used in latest wheat thresher in India for threshing as well as making good quality bhusa. Considering the above points there is a crucial need of small and efficient wheat thresher with maximum threshing and cleaning efficiency along with minimum losses and visible grain damage. In the existing small wheat thresher developed by Dubey (2004), both cylinder and blower are mounted on a wheat common shaft for which a desired threshing and cleaning efficiency are achieved with a greater percentage of visible grain damage and collective losses. The of bhusa obtain from the thresher was also not in permissible limit, that is why not accepted by local farmers. Keeping in view the above following, Lab and field-testing of Power Thresher for Wheat Crop as per B.I.S. test code. Evaluate the performance of power .thresher. Study the economic required of power thresher.

MATERIALS AND METHODS

Fabrication of Wheat Thresher

Wheat thresher was fabricated in the experiment in the department of Farm Machinery and Power as per the dimension specified. The functional component of the thresher have been shown in figure 1 & 2. The procedure adopted to fabricate different components of the thresher are as follows:

Frame

The frame was fabricated from 35x35x3 mm angle iron having over all dimensions 1100x700 400 mm. Two pieces of angle irons 25x25x3 mm having length of 1100 mm were welded 160 mm below from the upper surface of the main frame. The lower part of the frame was inclined 45^o outward having extension of 180 mm length for better support on ground. The main frame was extended 200 mm from one side to support the tractor PTO. 20 mm hollow square bars having 1100 mm length were welded on lower part for basal support of the frame. Lower concave, cylinder, blower and sieve assembly were attached by nuts and bolts on the frame.

Cylinder

It was fabricated as per design, diameter and length of 200 mm. The numbers of rectangular bars each having 280 mm. Length made of (30x5) mm flexed were fixed to the periphery of the cylinder with the help of pegs. The cylinder was

constructed with the help of two side rings made of 30x3 mm M.S. flats having inner diameter of 280 mm and 4 mm thick, which make the periphery of the cylinder. The bushes of diameter size 25x35 mm were welded at the center of cylinder for mounting the cylinder on the shaft with the help of nuts and bolts. The pegs were made from 12 mm bolts and one side of pegs was flattened up to 30 mm for better impact action. The diameter and length of pegs were 12 mm and 70 mm, respectively. Total 55 numbers of pegs were estimated on the basis of spacing between pegs used for fabrication. The cylinder shaft was having 25 mm diameter. The diameter of the shaft bushes was kept 28 mm to prevent the sliding movement of the cylinder aligning 6205 bearings were used for mounting the cylinder shaft on the frame the overall of the diameter of the cylinder after mounting the pegs was left 390 mm

Separating Section

The thresher was provided with two reciprocating screens which were fabricated with the help of angle irons (25x25x3) mm. The upper sieve was kept horizontal and 5 mm hole diameter sieve was used in its construction. The lower sieve was kept 400x600 mm in size with 1x1 mm wire mesh type. The aim of lower sieve was to remove dust and small weed seeds through clean grain and also to delivered grain to the outlet. The sieve assembly was kept as more at 1.6 rpm of cylinder speed through eccentric. The stroke length of sieve assembly was kept at 30 mm as per design. The sides of sieve were covered with 1 mm M.S. sheet to avoided spilling of grain material. The whole assembly was hanged on four arms for its moments. The lower sieve was kept at an inclination of 16^o from upper sieve. The minor adjustments in the slope of complete assembly were possible with the help of tightening or loosening of the nuts of the hangars.

Air Velocity

The air velocity of the blower was measured at the mouth of the air duct, at no load condition, with the help of an anemometer. An average of five readings was taken at five equal intervals on the centre line throughout the width of the duct. An air velocity of 415 m/min was kept constants for all test runs.

Unthreshed Grain

Partially threshed material coming out of the thresher was collected on analysis approach tarpaulin. All the unthreshed and partially threshed ear heads were sorted out from the straw. The unthreshed heads were rethreshed manually and the grain recovered was weighed. Percentage of the unthreshed loss was calculated by the following formula:

$$\mathbf{G_u = \frac{w}{W} x100}$$

where

G_u = Percentage of unthreshed grain

w = weight of grain separated from unthreshed ear heads in kg

W = total grain input in kg

Blown Grain

Partiality broken straw coming out of the thresher was collected and the threshed grain separated manually using analysis approach hand operated winnower. The percentage blown grain was collected as follows:

$$\mathbf{G_b = \frac{w}{W} x100}$$

where

G_b = Percentage of blown grain

w = weighted of threshed grain obtained at bhusa outlet in kg

W = total grain input in kg.

Cracked Grain

Five samples of clean grain weighing approximately 1 kg each were taken at random from the clean grain and divided into smaller fraction of about 200 gms. Cracked grain was sorted out manually from each of these samples and weighed. Percentage of cracked grain was calculated by using following formula:

$$\mathbf{G_c = \frac{w}{W} x100}$$

where

G_c = Percentage cracked grain

w = weight of cracked grain in gms

W = weight of sample in gms

Cleaning Efficiency

For finding the cleaning efficiency, 200 gms sample was weighed. The sample was cleaned again by separation. After cleaning the grain and chaff was weighed and the cleaning efficiency of the thresher was determined using the following formula:

$$\mathbf{C.E. = \frac{W-w}{W} x100}$$

where

C.E. = cleaning efficiency in percentage.

W = weight of chaff in the sample gm.

W = total grain sample taken, 200 gm.

Threshing Efficiency

A sample of 200 gms threshed material was collected and then cleaned. The clean grain was weighed on an electronic balance. The unthreshed grain were threshed again by hand beating, cleaned and weighed. They were used to find the threshing efficiency. The percentage of threshing efficiency was calculated using the following formula:

$$T.E. = 100 - \frac{w}{W} x100$$

where

T.E. = threshing efficiency in percentage

w = quantity of unthreshed grain in the sample

W = total grain in the sample

RESULTS ANDDISCUSSIONS

The Department of farm power and machinery was improved day by day improving the quality of grain threshed and minimize the grain losses and also improve the straw quality which is possible by improving the performance evaluation of the wheat power thresher. However the desired threshing and cleaning efficiency are achieved with a greater percentage of grain damage. The field testing of the thresher was carried out on the variety of wheat crop Sonalika. Before the test the thresher was set at 15 mm concave clearance at inlet, 13 mm at middle and 11 mm at outlet **(Behera *et al.* 1990).** The clearance between suction port and sieve was set at 20 mm for better aspirating action. The parameters such as capacity, threshing efficiency and cleaning efficiency, visible grain damage and non visible grain damage, sieve loss, blown grain percentage, average length of bhusa and power requirement were evaluated. The test was conducted at The Department of farm power and machinery of Baba Saheb Dr. Bhim Rao Ambedekar College of Agricultural Engineering & Technology, Etawah (Uttar Pradesh). The best combinations of cylinder speed, feed rate and blower speed on the selected wheat crop variety were carried out.

Pre-Test Observations

The power requirements of various functional Components of the thresher were studied under load and No-load conditions at five different speed of the cylinder. The change in the performance of the thresher e.g. grain Output, grain losses, threshing and cleaning efficiencies were determined. These data were analyzed to obtain the Optimum speed of the operation. The feed rate was kept constant For each replication at each of the speeds. The cylinder Concave Clarence was 2.5 cm and was kept constant throughout. The study the experimental data on the power requirement of The functional component and other performance factor are reported in appendix.

Effect of Cylinder Speed on different Losses

The thresher performance data is given in Figure 1 gives the different losses at various speeds of the cylinder. The looses considered were un threshed losses, Blown off losses, visible grain damage losses and the total losses.

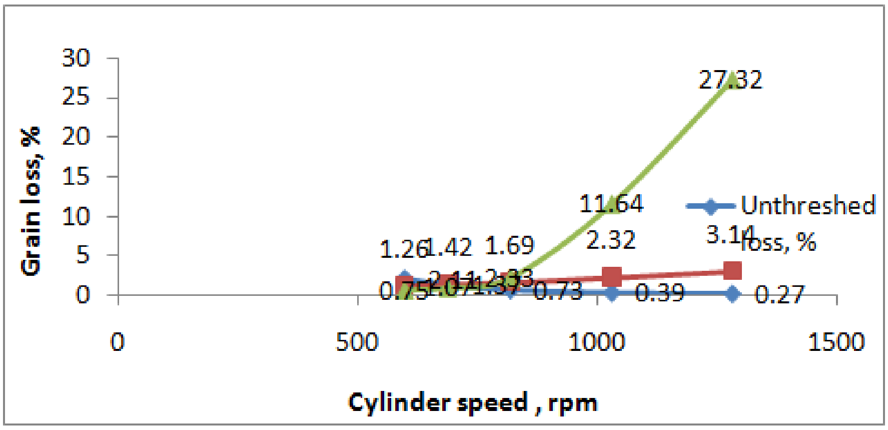

Figure 1: Effect of Cylinder Speed on Grain Loss

Effect of Cylinder Speed on Feed Rate and Grain Output

The relationship of cylinder speed with feed rate and Grain output is shown in figure 3. It was observed that the Feed rate increase with the increase in of cylinder speed. The average feed rate at a cylinder speed of 600 rpm (13.5 m/s) was found to be 611.20 kg/hr where as the grain output was of the order of 244.54 kg/hr. The feed rate increase linearly as the cylinder speed was inc. from 600 to 1030 rpm (13.5 m/s to 23.17 m/s), after wards further increase in cylinder speed did not appreciably increased the feed rate. From the figure 2 it was obvious that exceeding a cylinder Speed beyond 840 rpm (18.9 m/s) would not be justified. This was because beyond 840 rpm the total losses were more than 5 % i.e. the upper limit of ISI standard.

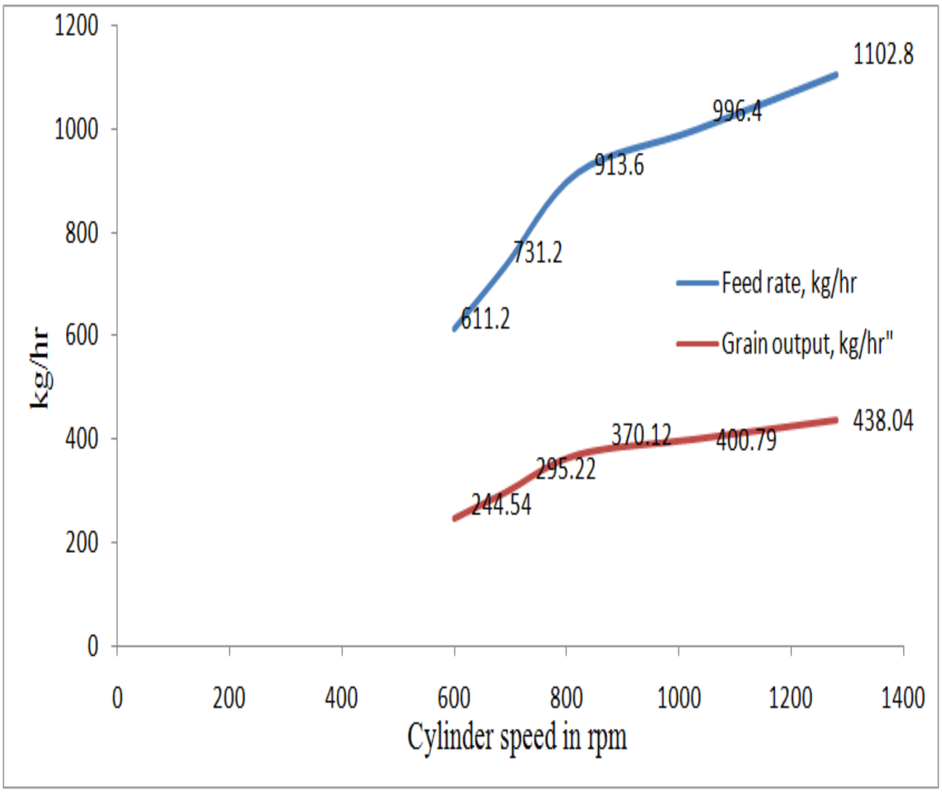

Figure 2: Effect of Cylinder Speed on Feed Rate and Grain Output

Threshing Efficiency

Threshing efficiency increase with increase in Cylinder speed up to 900 rpm (20.25 m/s) after that increment was very slow and the curve tried to level out at higher cylinder speeds. This was due to the reason that the grain needed certain force to be detached from the ear head. Since the impact and rubbing forces imparted by rotating cylinder to the grain varied with speed, therefore, at a particular speed only a fraction of grains present in the ear head would be threshed and this fraction of threshed grain increased at higher speeds. When the force exerted by cylinder on ear-head just equaled the maximum force needed to thresh all grain, the threshing efficiency became almost constant and approached 100 %. At a cylinder speeds of 840 rpm (18.9 m/s) where the total losses were 5% the threshing efficiency was found to be 99.38%.

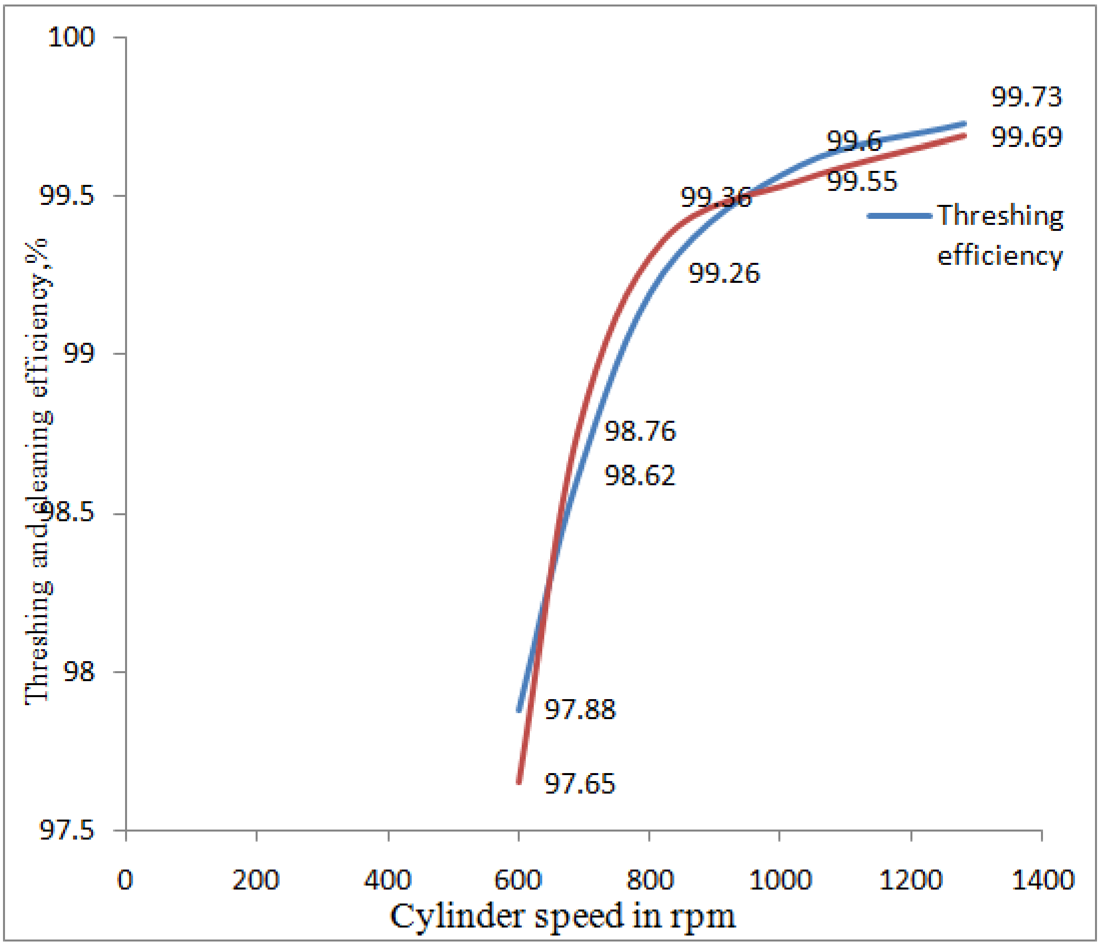

Figure 3: Effect of Cylinder Speed on Threshing and Cleaning Efficiency

CONCLUSIONS

The threshing efficiency was found in the range of 97.1% to 99.95%.The cleaning efficiency was found in the range of 99.59% to 99.29%.It was observed feed rate was highly significant for threshing efficiency. The visible grain damage found to be 0.41% to 2.57%. it was observed that visual grain damage was decreasing with the increasing feed rate in increasing of cylinder speed. The blower grain was found to be 0.07% to1.26%. The percentage of blower grain was found to be increasing with increasing in blower speed and feed rate for cylinder speed. The spilled grain was found to be range of 0.34% to 0.85%. It was observed that sieve losses increasing with increasing of cylinder at blower speed and decrease feed rate. The length of bhusa was found to be decreasing in term with the increasing in cylinder and blower speed and decreasing feed rate. The maximum length of bhusa was found to be 18 mm and 20 mm. At the above combination the threshing efficiency, cleaning efficiency, visual grain damage, total losses, respectively were found to be 99.88%, 99.29%, 92%, 1.78%, 1.81%, respectively. The threshing norms of BIS standards. The power requirement for operating the thresher at recommended cylinder speed 1152 rpm (22.9 m/s) 1440 rpm blower speed. Feed rate 5 kg/min was 1.2kg/hr. The optimum capacity of thresher was found to be 0.14 t/h and 0.147 t/h in actual field conditions.

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